D.P.U. 93-1A-A

Application of Boston Edison Company under the provisions of G.L. c. 164, § 94G for approval by the Department of the actual unit by unit and system performance of the Company with respect to each target set forth in the Company's approved performance program.

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I. INTRODUCTION

On January 5, 1993, Boston Edison Company ("BECo" or "Company") notified the Department of Public Utilities ("Department") of the Company's intent to file a quarterly change to its fuel charge in conformance with its tariff, M.D.P.U. 592-A, and to its qualifying facility power purchase rates in conformance with its tariff, M.D.P.U. 545-A, and the Department's rules governing such rates. The Company requested that both these changes be effective for bills issued pursuant to meter readings in February, March, and April 1993. The Company also asked the Department to review the performance program data for the Company's generating units for the November 1, 1991 through October 31, 1992, performance year.[1]

The Department held a public hearing on the Company's application on January 28, 1993, at the offices of the Department in Boston. Pursuant to G.L. c. 12, § 11E, the Attorney General of the Commonwealth of Massachusetts ("Attorney General") intervened in the proceeding. No other petitions to intervene were filed in the proceeding.

At the January 28, 1993 hearing, the Department announced its intent to extend the proceeding in order to investigate performance variances from the goals that had been established for the Company's generating units in Boston Edison Company, D.P.U. 91-176 (1992) (Tr. 1, at 3).[2]

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[1] In accordance with G.L. c. 164, § 94G, once a year, BECo is required to file with the Department the actual performance results of generating units in its performance program. Typically, the Company provides this data concurrently with its January fuel charge filing.

[2] On February 5, 1993, the Department issued an Order in Boston Edison Company, D.P.U. 93-1A establishing the Company's fuel charge for the billing months of February, March, and April 1993.

The Department held two days of hearings addressing generating unit performance matters, on March 26, 1993 and April 7, 1993. During the hearings, the Company presented two witnesses: William S. Clancy, deputy plant manager at the Company's Pilgrim Nuclear Power Plant ("Pilgrim"); and Peter C. Stanley, performance and reliability coordinator for the Company.

The Company, the Attorney General, and the Department entered into the record 70, 2, and 72 exhibits, respectively. The Company's responses to ten record requests issued by the Department and to three record requests issued by the Attorney General also were incorporated into the record of this proceeding. The Attorney General did not file a brief in this proceeding. The Company filed its brief on June 4, 1993.

II. PERFORMANCE REVIEW

A. Standard of Review

The Department is authorized to set a quarterly fuel charge for a company's recovery of prudently incurred costs for fuel and purchased power. G.L. c. 164, § 94G(b). To aid in determining the prudence of such costs at a later date, the Department is required to annually set performance goals for the generating units that provide electric power to jurisdictional electric companies. G.L. c. 164, § 94G(a). In goal-setting proceedings, a company proposes targets, subject to Department review, for both individual generating units and that company's overall system. The Department reviews the proposed goals and issues an Order establishing both unit and system-wide performance goals for the subsequent twelve-month period.

In particular, G.L. c. 164, § 94G(a) states in part that each company

> shall describe for the time period or periods designated reasonably attainable targets which shall include a thermal efficiency target for the performance of the company .... Such program also shall provide for the efficient and cost-effective operation of individual generating units by an electric utility company in meeting the minimum needs of each unit of said company to maintain sufficient reserves of power for purposes of reliability and efficiency. Such program also shall describe the historic data, industry standards or reports, simulation models or other information and techniques upon which projections of the company's performance are based and shall include, as goals for individual and system plant performance, availability, equivalent availability, capacity factor, forced outage rate, heat rate on a unit by unit basis and such other factors or operating characteristics required by the Department. Any such program may specify a value or a range of values for the operating characteristic in question and shall reflect operating conditions when overall performance is optimized.

The availability factor ("AF") of a unit is the fraction of time during which the unit is capable of generating power at any level. AF, which is expressed as a percentage, measures how often a unit was available to generate power, but is not a measure of the amount of power generated. AF takes into account the effect of planned outage-hours ("POH") and unplanned outage-hours ("UOH") on a unit's availability. POH are outage-hours that are scheduled well in advance of the date on which they occur. UOH comprise five categories of outage-hours. The first three categories ("UOH 1, 2 and 3"), also known as forced outage-hours ("FOH"), are outages caused by conditions that require removing a unit from service on, at most, a few days' notice. The fourth category ("UOH 4") represents maintenance outage-hours ("MOH"), which are outages that can be delayed beyond the end of the next weekend, but that take a unit out of service before its next planned outage. In the fifth category ("UOH 5") are outage-hours which extend a planned outage beyond its scheduled duration. The formula for AF is a ratio of period hours ("PH"), less POH and UOH, to PH; that is

$$AF = \frac{PH - POH - UOH}{PH}$$

The equivalent availability factor ("EAF") of a unit is the fraction of maximum generation that a unit would be able to produce if limited only by outages and deratings. Deratings are reductions in a unit's maximum power level. They can result from either unit conditions, such as equipment limitations, or seasonal conditions, such as ambient water temperature or environmental restrictions. EAF, expressed as a percentage, differs from AF in that it takes into account equivalent unit derated hours ("EUNDH") and equivalent seasonal derated hours ("ESDH"). EUNDH comprises equivalent planned derated hours ("EPDH") and equivalent unplanned derated hours ("EUDH"). Equivalent derated hours are calculated by multiplying the duration of each derating, in hours, by the number of megawatts by which the unit is derated, and dividing the product by the maximum capacity of the unit. Gross EAF is calculated by using the gross maximum capacity of a unit to calculate equivalent derated hours, while net EAF is calculated using equivalent derated hours based on maximum net capacity. Gross maximum capacity includes the capacity required to supply electricity to run the unit. Net maximum capacity ("NMC") is the maximum capacity available after station service requirements have been met. The formula for either net or gross EAF can be expressed as

$$EAF = \frac{PH - POH - UOH - EUNDH - ESDH}{PH}$$

Net capacity factor ("CF") is a ratio of the number of megawatt hours ("MWH") a unit has generated during a period of time in excess of station service requirements, compared to the maximum it could have generated if it had produced its net maximum capacity during the

entire period. CF indicates how much power a unit generated during a given period, compared to the maximum amount of power it theoretically could have generated during that period. CF is usually expressed as

$$CF = \frac{\text{Net Actual Generation}}{\text{NMC x PH}}$$

Forced outage rate ("FOR") measures the amount of time that a unit was completely out of service because of forced outages during a period, relative to the amount of time that the unit was actually in service during the same period. FOR takes into account the unit's FOH, but not the other types of unplanned outages. It is calculated by dividing FOH by the sum of FOH and service hours ("SH"). A unit's SH are the hours in a given period during which the unit was in service generating electricity. The formula for FOR can be expressed as

$$FOR = \frac{FOH}{FOH + SH}$$

Heat rate ("HR") compares the energy input used by a unit during a given period, expressed in British Thermal Units ("BTU"), to the electrical generation of the unit, in kilowatt hours ("KWH"), during the same period. HR is a measure of a unit's thermal efficiency. Net HR is usually expressed as

$$HR = \frac{\text{Fuel Energy Consumed}}{\text{Net Actual Generation}}$$

In accordance with G.L. c. 164, § 94G, the Department conducts annual goal-setting proceedings with each company over which it has authority to do so. In these proceedings, the performance programs submitted by a company are reviewed and goals are developed for

AF, EAF, CF, FOR, and HR based on the formulas described above. At the conclusion of goal-setting proceedings, the Department issues an Order establishing both unit and system-wide goals for a subsequent twelve-month performance period.

Also in accordance with G.L. c. 164, § 94G, the Department conducts annual performance review proceedings where in actual performance data obtained during a company's performance period are reviewed and compared to the goals that had been set for that period in a prior goal-setting proceeding. Should a company fail to achieve one or more of the goals established for a performance period under review, the company must present evidence explaining such variance at the next fuel charge proceeding. G.L. c. 164, § 94G(a). The Department conducts an investigation into the circumstances behind each failure. These investigations typically involve a detailed review of activities surrounding particular generating units in order to determine whether a company, in operating and maintaining its units, followed all reasonable or prudent practices consistent with the statute. Specifically, the Department must

> make a finding whether the company failed to make all reasonable or prudent efforts consistent with accepted management practices, safety and reliability of electric service and reasonable regional power exchange requirements to achieve the lowest possible overall costs to the customers of the company for the procurement and use of fuel and purchased power included in the fuel charge. If the department finds that the company has been unreasonable or imprudent in such performance, in light of the facts which were known or should reasonably have been known by the company at the time of the actions in question, it shall deduct from the fuel charge proposed for the next quarter or such other period as it deems proper the amount of those fuel costs determined by the department to be directly attributable to the unreasonable or imprudent performance.

G.L. c. 164, § 94G(a).

The Department's standard for determining the prudence of a company's actions appears at G.L. c. 164, § 94G.[3] If a company expects to recover its costs, including purchased power costs incurred as a result of unit outages, the company must "demonstrate the reasonableness of energy expenses sought to be recovered through the fuel charge." G.L. c. 164, § 94G(b). The Department is directed to disallow such costs if (a) the company fails to sustain its burden of proof that its actions were prudent, or (b) despite the company's making a prima facie case, the Department concludes that the company's actions were imprudent and proximately caused the fuel costs or incremental replacement power costs whose recovery is sought.[4] G.L. c. 164, § 94G.

In applying this standard, the Department has relied on critical path analysis, a method for determining whether a challenged company decision or discrete work item conducted during an outage may be judged to have caused or prolonged the outage.[5] See Fitchburg

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[3] "The statutory context... is provided by the authority granted the Department in G.L. c. 164, § 94G(a), to deduct from a fuel charge proposed for the next quarter the amount of those fuel costs determined to be directly attributable to a company's unreasonable or imprudent performance; and, in § 94G(b), to deduct that amount determined to be directly attributable to a company's defective operation of a unit. Each determination is to be made in light of the facts which the company knew or should reasonably have known at the time of the actions in questions." Boston Edison Co. v. Department of Public Utilities, 393 Mass. 244, 245 (1984).

[4] For the purposes of this proceeding, incremental replacement power costs are the difference between the costs for power to replace a unit which is not available for service across a given period, and the fuel and operating costs that would have been incurred had that unit operated during the period.

[5] Critical path analysis is a commonly-used planning tool in large engineering and construction projects. It may be applied prospectively (an "as-planned" critical path may be developed for use) during a project to direct activities, and retrospectively to assess the conduct of an outage and the prudence of outage management (an "as-built" critical path would reflect the sequences and durations of activities actually experienced). The result of a critical path analysis is a network graphically depicting a schedule of activities and their sequence, durations, logic, interrelationships, and

(continued...)

Gas and Electric Light Company, D.P.U. 87-5A-1, at 13 (1989); Boston Edison Company, D.P.U. 1009-G (1982).

A performance review addresses the performance of a company's units during the performance year. The performance of certain units in which that company has contractual rights to capacity or output, rather than ownership interests, is, in the first instance, the proper subject of other docket inquiries. In keeping with established precedent, should it be determined in other inquiries that imprudent or unreasonable actions resulted in lost availability of units from which a company also received power, the Department may disallow the recovery of resultant incremental replacement power costs incurred by that company, in order to protect ratepayers from the adverse consequences of any imprudence. Commonwealth Electric Company v. Department of Public Utilities, 397 Mass. 361, 366 n.2 (1986).

Since 1985, the Department has held that a company must refund to ratepayers incremental replacement power costs that result from imprudence committed by its

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[5](...continued)
dependencies.

The critical path through a generating unit outage is the chain of activities representing the shortest possible path through the last event of the outage. The sum total of the durations of each activity on the critical path defines an outage's total duration. If an activity on the critical path is delayed, by definition, an equal delay is realized in the completion of the outage. A complex outage may have more than one critical path; and these are known as concurrent or parallel critical paths.

The effect of a delay in an outage activity on the overall schedule can be assessed only against the critical path. An activity not on the critical path may be delayed but still have no effect on the duration of an outage or purchased power costs. But an activity not on the prospective or "as-planned" critical path also may be so delayed as to become itself the actual critical path and be deemed so in retrospect. Delay on the critical path does not necessarily result from imprudence: the cause may be conditions not reasonably foreseeable or preventable, new regulatory requirements, force majeure, etc.

independent contractors to whom the company delegates the responsibility for original or repair work. Boston Edison Company, D.P.U. 92-1A-A at 19-20, 42, 44 (1993); Nantucket Electric Company, D.P.U. 92-7B-A at 15 (1993); Boston Edison Company, D.P.U. 88-1A-A at 51 (1988); Boston Edison Company, D.P.U. 85-1B-2, at 15-18 (1985); Western Massachusetts Electric Company, D.P.U. 85-8F-2, at 12-13 (1985). A company may not insulate itself from responsibility for the conduct of its business by engaging contractors. Section 94G of G.L. c. 164 applies with equal force to a company's independent contractors on the principle that providing electric service is part of an electric company's "nondelegable statutory obligations." Commonwealth Electric Company v. Department of Public Utilities, 397 Mass. 361, 366 n.2 (1986).

B. Overview

The Department sets goals for units that BECo owns and operates, units in which it has an ownership interest but does not operate, and units from which it receives power under life-of-the-unit contracts. In D.P.U. 91-176, the Department set goals for BECo's major units (Mystic Units 4, 5, 6, and 7; New Boston Units 1 and 2; Pilgrim; and Canal 1) and minor units (Connecticut Yankee; Wyman 4; New Haven Harbor; Millstone Units 1, 2, and 3; Yankee Atomic;[6] Northfield 1, 2, 3, and 4; L Street Jet; Mystic Jet; Edgar Jets; Framingham Jets; and Medway Jets).

The instant performance review focuses on the actual performance of the above units during the performance year ended October 31, 1992. As in prior years, the Company's January 1993 fuel charge filing included the actual performance data for that performance

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[6] Yankee Atomic has been in deactivated status since February 26, 1992 (Exh. BE-PCS-3, at 21).

period and a discussion of performance-related activities. The Company provided a comparison of the actual operating results achieved by BECo's units to the goals set in D.P.U. 91-176 (Exh. BE-PCS-3, at 25). This comparison has been reproduced as Table 1 in this Order.

The information in Table 1 shows that some of the Company's major units did not achieve their EAF goals. Certain major and minor units also failed to meet other goals established in D.P.U. 91-176. Accordingly, the Department investigated the reported variances between the established goals and the actual performance of units in the Company's supply portfolio.

C. Performance Issues and Findings

1. Pilgrim

a. Introduction

Pilgrim is a 670 MW nuclear power plant, located at Rocky Point on Cape Cod Bay, Plymouth, Massachusetts. The facility has been in service since December 1972, and is owned and operated by BECo. After sales to other utilities, the Company receives 74.3 percent of Pilgrim's output.

During the November 1, 1991 through October 31, 1992 performance year, Pilgrim experienced two forced outages: the first in the fall of 1991; and the second in the spring of 1992. The Fall 1991 outage was caused by a severe storm; Pilgrim was out of service from October 31, 1991, until November 21, 1991. The Department found no evidence that the Fall 1991 outage resulted from any unreasonable or imprudent action by the Company. The Spring 1992 outage was the result of equipment malfunction; that outage began or

March 26, 1992, and lasted until April 13, 1992. A discussion of the Spring 1992 outage follows.

b. The Spring 1992 Outage

i. Background

On March 25, 1992, the Reactor Core Isolation Cooling ("RCIC") Inboard Steam Supply Isolation Valve MO 1301-16 failed.[7] More specifically, during a postwork testing of the valve, it failed to stroke properly and exhibited erratic position indication (Exh. BE-WSC-1, at 22). Repeated attempts to troubleshoot and repair the valve with Pilgrim on-line were unsuccessful. Therefore, on March 26, 1992, BECo decided to shut down Pilgrim in order to investigate and repair the MO 1301-16 valve (id.).

The Company's root cause analysis of the MO 1301-16 valve failure showed that the valve motor operator cap screws had been torqued improperly during their installation, which resulted in their loosening during operation and the consequent separation of the motor operator from the valve yoke (Exh. BE-WSC-15, Tab. 35).[8] The Company determined that the cap screws had been torqued improperly because the torque values that had been implemented were taken from the wrong guidelines (id.). The Company's witness, Mr. Clancy explained that the plant maintenance personnel had erroneously used a maintenance procedure by Limitorque Corporation ("Limitorque") rather than the vendor manual published by Westinghouse Electric Corporation ("Westinghouse") to determine the

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[7] The purpose of the MO 1301-16 valve is to control steam supply to the RCIC turbine (Exh. BE-WSC-1, at 24).

[8] The MO 1301-16 valve is a motor-operated valve that features the valve itself and the motor assembly that controls the valve. The cap screws attach the motor to the valve. The vendor of the valve assembly was Westinghouse Electric Corporation and the motor assembly was manufactured by Limitorque Corporation (Tr. 2, at 149).

torque values for the cap screws (Tr. 2, at 149). Because of seismic requirements for the valve, Westinghouse was responsible for specifying the appropriate torque value for the cap screws that attach the motor to the valve (id.). The Limitorque maintenance procedure was applicable only to the internal components of the Limitorque motor assembly (id.).

The Company identified several other repair activities performed during the Spring 1992 outage that are relevant to this analysis. First, on September 26, 1991, several months prior to the March 26, 1992 shutdown, the Company had identified a leak on the RCIC Outboard Steam Supply Isolation Valve MO 1301-17 (Exhs. BE-WSC-15, Tab. 30; DPU-32; Tr. 2, at 150).[9] Several attempts by the Company to eliminate the leak by tightening the valve did not fully stop the leak, but the plant was able to continue operation because the Pilgrim Technical Specifications did not require a shutdown based on a limited leak at that valve (Exh. BE-WSC-1, at 19-20; Tr. 2, at 151, 157-158). Mr. Clancy explained that no formal requirements or strict limitations exist relevant to a leak of the MO 1301-17 valve, that would have necessitated a shutdown of the plant (Tr. 2, at 157-158). According to Mr. Clancy, the Company wrapped the leaking valve with a fiberglass cloth and a piece of steel mesh in order to keep the area habitable (id. at 151-152). The Company continued monitoring the progression of the leak, but no records of the leak progression were prepared by the Company (id. at 156). Mr. Clancy testified that despite the Company's efforts to eliminate the leak, it progressed from a relatively small steam flow to a steady stream of water (id. at 151). On January 30, 1992, the Company had prepared a preliminary schedule

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9 The MO 1301-17 valve and the MO 1301-16 valve are installed in series on the RCIC turbine steam supply line, one outside the drywell, the other inside the drywell (Exh. BE-WSC-1, at 24). The drywell is a steel-lined, concrete pressure vessel that houses the reactor vessel and the reactor recirculation system (Exh. BE-WSC-4, at 4).

of an eight-day forced outage to repair the MO 1301-17 valve (Exh. BE-WSC-15, Tab. 2). Nonetheless, in March 1992, the Company planned to continue operation of the plant until the mid-cycle outage that was scheduled to commence on October 17, 1992 (Exhs. BE-WSC-1, at 21; BE-WSC-15, Tab. 19, at 7). During the Spring 1992 outage, the Company disassembled the MO 1301-17 valve and replaced the seal ring inside the valve (Exh. BE-WSC-1, at 24).

A second repair activity during the Spring 1992 outage that is relevant to this discussion pertained to an observation in December 1991 that the rate of leakage from unidentified sources in the drywell started to increase (Exh. BE-WSC-15, Tab. 6). Between December 1991 and March 1992, the Company closely monitored the rate of leakage in the drywell because the Pilgrim Technical Specifications require a plant shutdown if the rate of leakage from unidentified sources in the drywell exceeds five gallons per minute (id.; Exh. BE-WSC-15, Tab. 5). During the Spring 1992 outage, the Company inspected the drywell and discovered that the sources of the leakage were deficient seals in two control rod drives (Exh. BE-WSC-1, at 28). The replacement of the seals was performed in parallel with major repair activities (id.).

A final repair activity addressed the problem with a turbine thrust bearing. On March 28, 1992, while the turbine was cooling down subsequent to the shutdown of the unit, the control room received a wear alarm regarding a turbine thrust bearing (id. at 24). The inspection of the turbine thrust bearing revealed that the hold-down bolts on the thrust bearing ring had loosened, and, therefore, as the turbine was cooling down, the contracting turbine and generator rotors were able to move the thrust bearing assembly in an axial direction enough to trigger a false activation of the thrust bearing wear alarm

(Exh. BE-WSC-16, Tab 10, at 2). According to design documents, the hold-down bolts were secured by small set screws (id.). The record shows that in 1987 General Electric Company ("GE") personnel performed maintenance work on the turbine thrust bearing; however, a torque value for the hold-down bolts was not documented at that time (id. at 3).

According to the record, the Company did not perform an evaluation to determine whether the loosening of the hold-down bolts resulted from a design deficiency (Exh. DPU-44). It was the Company's conclusion that the loosening of the bolts most likely resulted from normal vibration experienced across the preceding five years (id.; Exh. DPU-70).

The record shows that since 1987, operating vibration on the turbine bearings has never exceeded normal levels (Exh. DPU-44). However, Mr. Clancy explained that during startup and shutdown of the turbine, transient vibration levels may have exceeded temporarily normal levels (Tr. 2, at 174). According to Mr. Clancy, those transient vibrations might have affected the tightness of the bolts because the bolts were not "staked"[10] (id.; Exh. DPU-44).

According to the record, many large steam turbine generators featuring hold-down bolts of the same design have not experienced similar problems (Exh. DPU-44). The Company identified just one similar event at Bridgeport Harbor 3 (Tr. 2, at 175). The record also shows that, in the period preceding the failure, the turbine at Pilgrim did not experience vibration levels higher than those typically experienced at other comparable power plants (Exh. DPU-44).

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[10] Mr. Clancy explained that the term "staked" signifies a design featuring a hole drilled in the bolt, with a steel rod inserted into the hole and welded in place in order to prevent the bolt from loosening during operation (Tr. 2, at 176).

Between March 26, 1992 and April 8, 1992, the Company performed repairs to both valves, MO 1301-16 and MO 1301-17, identified the other sources of the drywell leakage and took action to correct them, and repaired the turbine thrust bearing. According to the record, the repairs to the MO 1301-16 valve started on March 27, 1992, and were completed on April 1, 1992 (Exh. BE-WSC-15, Tab. 45). The Company performed the repairs to the MO 1301-17 valve in parallel to the work on the MO 1301-16 valve, and completed those repairs two days later on April 3, 1992 (id.). On March 31, 1992, the Company initiated the inspection of and repairs to the turbine thrust bearing, and those activities were finished on April 8, 1992 (id.). On April 13, 1992, after other necessary activities had been completed by the Company, Pilgrim was returned to service (id.).

ii. Company's Position

The Company states that although the failure of the MO 1301-16 valve was the cause of the shutdown, the repairs to that valve did not affect the critical path and duration of the outage (Company Brief at 31). The Company maintains that during the first five days of the outage, i.e., from March 26, 1992 through March 31, 1992, the critical path of the outage encompassed the repairs to the MO 1301-17 valve (id. at 29). The Company asserts that the leak in the MO 1301-17 valve was unforeseeable and that the Company's actions were reasonable and prudent (id. at 30). The Company suggests that, if the MO 1301-16 valve had not failed on March 25, 1992 initiating the Spring 1992 outage, the progression of the MO 1301-17 valve leak or the progression of unidentified leakage in the drywell probably would have caused a forced outage of the plant sometime during the summer of 1992 (id. at 28, citing Tr. 2, at 70, 157; Tr. 2, at 159).

The Company asserts that the inspections and repairs to the turbine thrust bearing became the critical path on March 31, 1992, and that those activities remained on the critical path until April 8, 1992 (id.). The Company maintains that the turbine thrust bearing hold-down bolts became loose "as a result of normal vibration during operations over the [previous] five years" (id. at 32, citing Exhs. BE-WSC-16, Tab 10, at 2; DPU-70; Tr. 2, at 173-174). The Company asserts that the turbine thrust bearing problem was unforeseeable and that the Company's actions in addressing the turbine thrust bearing problem were reasonable and prudent (id. at 33).

iii. Analysis and Findings

(A) The Motor Operated Valves

The record demonstrates that the Spring 1992 outage at Pilgrim was precipitated by the failure of the MO 1301-16 valve. The record shows that the inoperability of the MO 1301-16 valve resulted from the separation of the motor operator from the valve yoke. The record also shows that the separation of the motor operator from the valve body resulted from the loosening of improperly torqued cap screws that attached the motor operator to the valve. The record shows that the Westinghouse valve manual, with correctly specified torque values for the cap screws, was available to the plant maintenance personnel; however, Company personnel erroneously derived the torque values from a Limitorque maintenance procedure rather than from the Westinghouse valve manual. The Company failed to identify any reason that would justify the error. Therefore, the Department finds that the Company's failure to properly torque the MO 1301-16 valve's cap screws represents an unreasonable action on the part of the Company. Consequently, the Department finds that the March 26, 1992 shutdown of Pilgrim resulted from an unreasonable and, therefore, imprudent action.

The record shows that between March 26, 1992 and March 31, 1992, while repairs to the MO 1301-16 valve were under way, the Company performed repairs to the MO 1301-17 valve in parallel. The Company asserts that, between March 26, 1992 and March 31, 1992, the repairs to the MO 1301-17 valve represented the critical path of the Spring 1992 outage, rather than the repairs to the MO 1301-16 valve. Thus, it is the Company's position that the MO 1301-16 valve repairs did not affect the duration of the outage and, consequently, that no replacement power costs are attributable to the failure of the MO 1301-16 valve.

In Western Massachusetts Electric Company, D.P.U. 88-8A-4, at 17 (1989), the Department determined that where the initial cause of an outage was adjudged imprudent, "the burden should rest on the company to support any claims that prudent repairs necessarily extended the length of the outage." In that Order, the Department stated that a company cannot "mask" the affects of an imprudent action with "made work" in order to shield itself from adverse findings by the Department. However, a company does have an opportunity to demonstrate that other activities performed during an outage precipitated by imprudent actions addressed unavoidable problems that would have caused unit down-time had they gone unaddressed. Such demonstration may lead to findings by the Department that an imprudent action was of limited consequence. Id.

Mr. Clancy suggested that if the MO 1301-16 valve had not failed on March 25, 1992, and the Spring 1992 outage had not occurred, the progressive leak of the MO 1301-17 valve probably would have caused a forced outage of the plant sometime during the summer of 1992. The Department finds the witness's assertion that the progressive leak of the MO 1301-17 valve would have necessitated a shutdown of the plant sometime in the summer of 1992 to be speculation that is not supported by any evidence in the record. No evidence

was presented by the Company to document the escalating progression of the leak between September 1991 and March 1992. The record shows that the Company had effectively implemented remedial measures in order to control the stream of water and steam emanating from the valve, directing it into the drain system. The record also shows that in March 1992, the Company had planned to continue operation of the plant until the planned mid-cycle outage. The mere fact that the Company prepared a preliminary schedule for repairs to the MO 1301-17 valve does not indicate that the condition of the MO 1301-17 valve would have required a forced shutdown of the plant prior to the mid-cycle outage. The record shows that no formal requirements or strict limitations exist relevant to a leak of the MO 1301-17 valve that would have necessitated a shutdown of the plant. The Department finds no evidence in the record that the condition of the MO 1301-17 valve precipitated a forced shutdown of Pilgrim in March 1992, or would have precipitated a forced shutdown of Pilgrim before the mid-cycle outage. Therefore, the Department finds that the Company failed to support its claim that the repairs to the MO 1301-17 valve necessarily extended the Spring 1992 outage from March 26, 1992 to March 31, 1992.[11]

In hearings, Mr. Clancy also suggested that the progression of unidentified leakage in the drywell also would have forced the plant off-line before the next planned outage, sometime during the summer of 1992. However, a review of a graph depicting the progression of unidentified leakage in the drywell (Exh. BE-MSC-15, Tab. 6) suggests that it is unlikely that the rate of the leakage would have exceeded the Technical Specifications' limit of five gallons per minute before mid-October. Consequently, the Department finds no

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[11] Our finding does not suggest that the Company was unreasonable in taking advantage of the outage resulting from the MO 1301-16 valve's failure to repair the MO 1301-17 valve.

evidence in the record that a forced outage caused by an excessive rate of unidentified leakage in the drywell likely would have occurred prior to the planned mid-cycle outage in October 1992.

Accordingly, the Department finds that a five-day portion of the critical path of the Spring 1992 outage, from March 26, 1992 to March 31, 1992, is directly attributable to the Company's unreasonable action: improper torquing of the MO 1301-16 valve's cap screws.

(B) The Turbine Thrust Bearing

The record shows that between March 31, 1992 and April 8, 1992, the Company performed inspections of and repairs to the turbine thrust bearing. The record is clear that the turbine thrust bearing alarm resulted from an axial shift of the turbine-generator rotor during cool down, which was caused by a loosening of the hold-down bolts on the bearing ring. The Company has suggested that the loosening of the hold-down bolts on the turbine thrust bearing ring was unforeseeable and resulted from normal vibration of the turbine. Therefore, the Company asserts that the portion of the critical path between March 31, 1992 and April 8, 1992, is not attributable to any unreasonable or imprudent action by the Company or its contractor.

Because many large steam turbine generators featuring hold-down bolts on the turbine thrust bearing of the same design as at Pilgrim have not experienced loosening of those bolts, we find that the design of the hold-down bolts on the turbine thrust bearing ring at Pilgrim is inherently sound and is not a likely root cause of the bolts' loosening. The record also shows that, in the period preceding the failure, the turbine at Pilgrim did not experience vibration levels higher than those typically experienced at other comparable power plants. If normal vibration had caused the loosening of properly torqued bolts at Pilgrim, normal

vibration should have caused the same problem at many other power plants with a similar design. Since only one other plant of many with a similar design has experienced this problem, the Department cannot agree with the Company's assertion that the hold-down bolts loosened due to normal vibration of the unit during operation.

According to the record, GE personnel did not document the torque value implemented during the maintenance work on the turbine thrust bearing in 1987. The record suggests that GE did not prescribe or apply any specific torque value that would be adequate to secure the hold-down bolts; consequently, it is likely that the actual torque values applied to the hold-down bolts were random. Therefore, the Department finds that the hold-down bolts on the turbine thrust bearing ring most likely loosened during operation because GE persomel failed to torque the hold-down bolts properly during the 1987 maintenance to the turbine thrust bearing. Therefore, the Department finds that the Company failed to make all reasonable or prudent efforts regarding maintenance of the turbine thrust bearing consistent with accepted management practices and the reliability of electric service to achieve the lowest possible overall costs to customers. The Department also finds that an eight-day portion of the critical path of the Spring 1992 outage, from March 31, 1992 to April 8, 1992, is directly attributable to this unreasonable performance.

iv. Conclusion

Overall, the Department finds that a thirteen-day portion of the critical path of the Spring 1992 outage at Pilgrim, between March 26, 1992 and April 8, 1992, can be attributed directly to the Company's or its contractor's unreasonable actions.[12]

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[12] Although the Spring 1992 outage was completed on April 13, 1992, the Department finds no evidence that the Company's activities performed between April 8, 1992 and (continued...)

In accordance with the precedent set forth in Section II.A, above, the Department finds that the Company bears ultimate responsibility for the unreasonable action by its independent contractor, GE. Accordingly, the Department finds that ratepayers should not bear the costs of the imprudent actions of the Company's independent contractor and, therefore, hereby directs the Company to calculate the expenses associated with a thirteen-day portion of the outage, from March 26, 1992 to April 8, 1992, caused by improper torquing of the MO 1301-16 valve's cap screws and improper torquing of the hold-down bolts on the turbine thrust bearing, and to refund to ratepayers, with interest, the incremental replacement power costs associated with this portion of the Spring 1992 outage at Pilgrim.

2. Mystic 4

a. Introduction

Mystic 4 is a 135 MW fossil unit located at Mystic Station, Everett, Massachusetts. The unit has been in commercial operation since 1957, and is owned and operated by Boston Edison Company. During the subject performance year, Mystic 4 experienced a major overhaul, which commenced on September 12, 1992 (Exh. BE-PCS-3, at 7A). A discussion of a single issue related to the Fall 1992 major overhaul at Mystic 4 follows.

b. The Fall 1992 Major Overhaul

i. Background

At issue is a decision by BECo management to delay repairs to the Mystic 4 condenser, which resulted in the unit operating at a reduced output over an extended period of time.

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[12](...continued)
April 13, 1992, which addressed safety-related issues, were attributable to any unreasonable or imprudent actions by the Company. Accordingly, the Department finds no evidence that those activities unreasonably extended the length of the Spring 1992 outage.

This derating of the unit caused the Company's ratepayers to incur additional costs for replacement power.

According to the Company, Mystic 4 began to experience numerous condenser tube leaks in 1988 (RR-DPU-8, Att. 2, at 5, 7). In the spring of 1991, the Company determined that the condenser tubes were failing at a rapidly increasing rate and concluded that replacement of the condenser tubes would be required during the 1992 major overhaul, scheduled to begin on April 25, 1992 (id. at 5-6). The Company's Production Engineering Department ("PED") performed a cost/benefit analysis of various options with respect to the tube replacement (id. at 7-11). On May 14, 1991, PED completed project justification for capital authorization for replacement of the tubes in the Mystic 4 condenser (id. at 5-11; Tr. 3, at 31; Exh. DPU-47). In order to avoid unplanned outages at Mystic 4 caused by leaks in deficient condenser tubes that could occur prior to their replacement, the Company reduced the boiler operating pressure beginning on July 21, 1991 (Exhs. BE-PCS-1, at 10; BE-PCS-24, at 7). The reduced pressure had the effect of limiting stress on the existing tubes (id.). However, the reduction of the boiler operating pressure caused the restriction of the normal capacity of the unit from 135 MW to 115 MW (Exh. BE-PCS-1, at 10).

In December 1991, at the Company's annual capital authorization meeting, the Company's Board of Directors approved the condenser tube replacement project (RR-DPU-8, Att. 2, at 1; Exh. DPU-47).[13] After the project was approved, the Company ordered the necessary material (titanium tubes) for replacement of the condenser tubes (Exh. DPU-47).

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[13] According to the Company, the Board of Directors reviews and approves the capital budget for the next calendar year at its annual meeting in December (Tr. 3, at 85). The Company stated that only emergency projects can be reviewed by the Board of Directors outside of the usual capital budget process (id. at 85-86).

Since the Company knew that the materials could not be shipped in time for the scheduled April 25, 1992 major overhaul, the Company rescheduled the major overhaul from April 25, 1992 to September 12, 1992 (id.; Exh. BE-PCS-3, at 7A).

The Company's decision to delay the 1992 major overhaul from April 25, 1992 to September 12, 1992 resulted in Mystic 4 operating at a reduced output over an extended period of time. This derating of the unit caused the Company's ratepayers to incur additional costs for replacement power during the summer of 1992, when demand for Mystic 4's power materialized. Operation of Mystic 4 with the 20 MW derating from May 1, 1992 to October 31, 1992 resulted in 19.4 equivalent outage days for this unit (Exhs. DPU-47; DPU-51).

ii. Company's Position

The Company contends that the delay of the Mystic 4 major overhaul from April to September 1992 was reasonable and prudent (Company Brief at 11). The Company argues that it conducted a careful and thorough decision-making process that was justified by the magnitude of the capital expenditures associated with the condenser tube replacement project (id. at 12).

The Company asserts that its decision to postpone the major outage was reasonable, because the resulting capacity restrictions and financial losses were relatively small in comparison to the capital expenditures associated with the condenser tube replacement project (id.). Also, since there was little demand for Mystic 4's power in 1991, replacement of the condenser tubes was not categorized as an emergency project (id.). In conclusion, the Company contends that its decision to delay the review and approval of the project by the Board of Directors until December 1991 was reasonable (id.).

iii Analysis and Findings

The Department notes that although the PED presented the results of its analysis of the condenser tube replacement project on May 14, 1991, the Board of Directors did not review the project until December 1991. Based on its analysis of the record, the Department finds that if the Board of Directors had reviewed and approved the project shortly after the completion of the PED analysis, the materials for the tube replacement could have been ordered and received prior to the scheduled April 1992 major overhaul. The Department therefore finds that the Company's decision to delay the major overhaul for Mystic 4 would not have been required if the Company had adopted PED's recommendations and ordered the materials for replacement of the tubes in a timely manner.

The Company argues that its delay in reviewing and approving PED's recommendations was justified since the project required a substantial capital outlay and was not classified by the Company as an emergency. The Department notes that the primary reason given by the Company for its decision not to classify the tube replacement project as an emergency was the relatively low demand for Mystic 4's power during 1991 in relation to the high cost of the repairs. At the hearing, the Company emphasized that it has a finite amount of capital to apply to capital projects in any particular year (Tr. 3, at 86). The Company also stated its view that the relative priority of the condenser tube replacement project on Mystic 4 must be judged in relationship to the other projects that the Company must undertake (id.). The Company asserts that it was appropriate to prioritize all capital expenditures before committing to the condenser replacement project (Company Brief at 12).

The Department does not question the Company's initial decision to delay the condenser repairs until the next regularly scheduled major overhaul. Consequently, the

Department does not intend to penalize the Company for any replacement power costs incurred between the start of the derating on July 21, 1991 and April 25, 1992, the originally scheduled date for the commencement of the major overhaul. The Department finds, however, that the Company failed to establish that there was little likelihood of a need for Mystic 4 in 1992 based on its performance in 1991 alone. The Department does not find it reasonable or prudent for the Company to substantially delay necessary repairs to a major unit based on the Company's speculative anticipation of future low power demands.

In addition, the Department finds that the Company failed to establish that it was reasonable under the circumstances to delay a repair to a major unit based on its own internal prioritization of capital expenditures. The Company did not identify any capital expenditures that were or could have been a higher priority than the condenser tube repairs at Mystic 4; nor did the Company provide information to the Department on the actual amount of capital available during 1991 and 1992 for expenditure on capital projects.

In 1983-1984, the Department examined the Company's decision to delay the replacement of the similar tubes in the Mystic 7 condenser. Boston Edison Company, D.P.U. 1009-N-1, at 6-33 (1984). In that proceeding, the Department found that the Company failed to justify delaying the condenser tube replacement, even though the Company presented evidence of competing repair needs. Id. at 16.

iv. Conclusion

The Company has an affirmative obligation to make all reasonable and prudent efforts consistent with accepted management practices, safety, and reliability of electric service to achieve the lowest possible overall costs for its customers. G.L. c. 164, § 94G(a). The Department finds that the Company acted unreasonably in delaying the consideration of

PED's recommendations until the December 1991 Board of Directors meeting. Furthermore, the Department finds that the Company's decision to delay consideration of PED's recommendations by the Board of Directors led directly to the Company's later decision to reschedule the commencement of the Mystic 4 major overhaul from April 25, 1992 to September 12, 1992. During the period from April to September 1992, the unit was forced to continue to operate with a reduced capacity, resulting in additional replacement power costs.

Accordingly, the Department finds that ratepayers should not bear the cost of the Company's imprudent decision to delay the order of the materials for replacement of the condenser tubes. In accordance with established precedent, the Department hereby directs the Company to calculate the expenses associated with the derating caused by the delay of the major overhaul at Mystic 4 that resulted in 19.4 equivalent outage days, and to refund to ratepayers, with interest, the incremental replacement power costs associated with this derating.

3. Other Units

During the course of this investigation, the Department also reviewed data and exhibits submitted concerning other generating units of BECo for which goals were established in D.P.U. 91-176. The Department finds no evidence that any outage or derating at these units during the performance year resulted from unreasonable or imprudent actions by the Company.

III. ORDER

Accordingly, after due notice, public hearing, and consideration, it is

ORDERED: That all incremental replacement power costs incurred by Boston Edison

Company attributable to (1) a thirteen-day portion of the unplanned outage at Pilgrim from March 26, 1992 through April 8, 1992, and (2) a derating of Mystic 4 caused by a delay of its major overhaul totalling 19.4 equivalent outage days, as described herein, be and hereby are disallowed; and it is

FURTHER ORDERED: That the Company shall in its next fuel charge filing provide for the refund to ratepayers, with interest, of any costs disallowed herein that have already been recovered through the Company's fuel charge; and it is

FURTHER ORDERED: That the Company shall, with its fuel charge filing for the months of February, March, and April 1994, submit performance data for the Company's generating units and for its system as a whole for the performance year ended October 31, 1993, and explain any variances from the goals approved by the Department in Boston Edison Company, D.P.U. 92-182 (1992).

By Order of the Department,